A SUCCESSFUL MUTANT OF VERBENA WITHOUT EXTERNAL ISOLATION.*

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While botanizing in Clay County, Kansas, during the past summer, I discovered a peculiar type of *Verbena stricta* Vent. The color of the flower in this species, in Kansas, is quite uniformly a deep purplish-blue. One may occasionally find a slight variation in shade in isolated individuals. But these fluctuating variations are insignificant both in number and degree. The peculiar form which I discovered was very different from the type and its variants. The color of the corolla was a pinkish-white and the individuals, numbering several thousands, were found to be remarkable for the uniformity of this character. There were no transition forms whatever. The mutant had a much smaller color variability than the parent species, and no other peculiarity. than the color of the corolla was discovered.

The mutants covered about a square mile of territory. In some directions, however, they have advanced for nearly a mile beyond what seems to have been the center of distribution. An isolated specimen was found two miles northeast of this center. A knowledge of the exact position of these mutants may be of some importance in the future. They are found, for the most part, on Section 26 of Town 7 South, Range 1 East, Clay Co., Kansas, and bloom the last week in July and the first in August. The whole central part of the section is rough land and has never been cultivated. It contains creek bottom land, ravines, hillsides, and high prairie. The soil is very diverse, containing most of the soil types present in the region. The mutant was found indifferently on nearly all kinds of soil and habitat which the section afforded. In some places the normal type was more abundant, in others the mutant, while in still other spots both were present in about equal numbers, growing together closely intermingled.

We have here, then, a sharply defined color variety which raises many interesting and disputed questions. The new form is clearly a mutant differing from the parent stock in a single distinct character. It originated in its native environment under normal conditions. The new color arose suddenly from one or more normal parents instead of through the cumulative effect of selection by insects of minute fluctuating variations. In fact the whole hypothesis of the origin of distinct colors in flowers by selection through the agency of insects, or otherwise, falls to the ground so far as this case is concerned. The old form has not been affected by the origin of the new either through variation or cross fertilization. Now de Vries says that "we

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must conclude that new species are produced sideways by other forms, and that this change affects only the produced and not the producer". The Verbena mutant is an example exactly to the point. But in using the term "mutant," I do not wish to be understood as necessarily accepting de Vries' notions of the hereditary apparatus wihch produces mutants.

The color of this mutant is probably a unit character with Mendelian dominance or recessiveness and for this reason the new race remains pure though growing together with the old. If the character is not Mendelian there must be some physiological peculiarity which prevents cross-fertilization as cross-pollination must certainly take place. Many generations must have preceded the present progeny and a considerable number of years must have passed since the origin of the first mutant.

This mutant is not of hybrid origin. Hybrids between certain species of Verbena are common but are easily recognized from morphological characters. No hybrids were found in the locality. A careful search was made in all directions from the mutant section but no other individuals were found except the one individual noted above. This could easily have been transported from the original locality. Whether the same mutation has occurred at other times or in other localities, I have at present no means of knowing. But it is not unlikely that it has appeared in other places also.

Some have claimed that mutations have been observed mostly among domestic forms. This is true, because these are far more accessible for ordinary observation than wild species. But with proper investigation mutants may turn out to be as abundant in the field as in the garden. One must live in the field and be thoroughly familiar with the plants of the locality before he is likely to notice even the more striking mutations, should he be so fortunate as to pass by their isolated habitat.

DeVries' Oenothera lamarckiana was introduced into Europe from America. The species had thus undergone a great change of environment and objections have been made to some conclusions based on the mutants of this species, yet it seems to me without reason. I have myself observed types of Oenothera biennis in Kansas which agreed with no descriptions given in the manuals. Moreover, the question as to what conditions are favorable to or cause mutation is not directly involved in the question of the fact of mutation. We have in nature most of the peculiarities of environment which we can produce artificially and primarily it makes no difference as to the fact of evolution by mutation whether the elementary species arises on a virgin prairie from an indigenous species like the Verbena stricta mutant, or from an exotic plant cultivated in a highly artificial garden. Many of the most important principles and

processes of evolution can be discovered only through series of pedigree cultures. The peculiar notion, that species, to be good species, must have their origin in the field, or nature's garden, and not in man's, has come down to us from a previous generation. This notion with other modes of thought, formulae, and assumptions has been so diffused through scientific thought and literature that it is held by many as a kind of dogma which if logically applied would exclude experimentation entirely as a factor in determining the character of evolution and speciation.

Any mutation which is Mendelian may theoretically give rise to a new race under favorable conditions. At the present time one may sometimes find two or three species according to the systematist among the branches of a single tree. There is, therefore, no occasion to waste words as to what is a true species or elementary species, nor how great or small a variation must be before it may be called a mutation. The real test should be as to whether the type breeds true without special selection or isolation. Recently the claim has been made by certain natural selectionists that it is selection and segregation that makes mutants breed true. But deVries' mutants and the Verbena mutant have, so far as anything can be determined by field observation, the quality of breeding true, created by or along with the original mutation process and not by selection. Perhaps if I were able to study and test some of the qualities of the Verbena mutant by means of definite pedigree cultures, the claim would again be made that the method employed was a process of selection. Although the Verbena mutant is a decided saltation, there is no reason why a similar change should not take place in a given locality by a series of very small advances, the saltation so to speak, continuing through a number of generations before again coming to a more or less fixed type. But this is outside of the questions raised by the case in hand.

The opinion has been commonly held for many years that sports, in the old sense of the term, are lost by the swamping effect of cross-breeding. But if there are variations which are not swamped, selection becomes an unnecessary factor in the origin of distinct forms; and the Verbena mutant is a case in evidence of a distinct type entirely successful from the beginning. This belief that sports are always swamped is, however, largely based on assumption.

Geographical isolation has, recently, also been claimed to be the important factor in speciation. The statement that no two closely related species or subspecies occupy the same territory or even the same habitat certainly appears ill-founded to anyone acquainted with the distribution of plants In many cases, according to Britton's Manual, the variety has the range of the type and this is true for species where the habitat is of a uniform

character. Other varieties appear to be localized either in the center of the distributional area or at one side of it although still within the limits occupied by the type. Geographical botany in America is still in its infancy. and it is a question whether much weight is to be attached to present statements in regard to distribution; but there is no more certainty as to the data concerning subspecies localized in geographically distinct areas, whether isolated by physiographic or climatic barriers. In the Verbena mutant we have not only a distinct type which originated by a saltation in a definite direction but a type which spread side by side in the same habitat with the parent and kept itself distinct without the aid of external selection or isolation of any kind. The isolation in this case is resident in the internal nature of the plant and had its origin in the same physiological and hereditary processes which gave rise to the original mutant.

It is assumed by many that, in case a new species arises with a character or quality more advantageous than the old, the new will finally displace the old through the struggle for existence. This is a hypothetical assumption which often appears to be without foundation in fact. If conditions of habitat were uniform and if each species lived in only one type of habitat and could endure only one narrow set of conditions there would be grounds for the general assumption. But most species can live in quite diverse habitats and under quite diverse and varying degrees of favorable and unfavorable conditions. There is a great difference in the character of plants adapted to similar habitats and still on a natural prairie conditions settle down to a sort of equilibrium with a complex flora where one species or at most a few ought to hold complete sway. The physiography, the habitat, the soil, and the plants are always shifting, always changing; and in this constant shifting and changing room is made not only for the stronger but also for the weaker. Burrowing animals, rain, wind, and gravity, are ever at work. It is not always necessary for the new type to migrate to a separate geographical area in order to survive unless its nature has been changed to such a degree as to put it out of all harmony with its surroundings. The two forms may divide the diverse and varying habitats of the region between themselves and exist side by side for an indefinite period just as the parent stock before division shared the habitat with others. Or one might say that the wild species may continue to exist in a continually changing physiography for much the same reason as cultivated plants continue to exist in man's cultivated field. And finally, is it not immaterial whether a species, to be a good species, cover a square mile or a continent, whether it continue for ten generations with a few thousand individuals or for a geological period with countless millions?